lution. The watchword of modern scientific culture is independence of thought and investigation, "Whatsoever is, may be wrong!" Its most cherished palladium is freedom to think, freedom of research, freedom in teaching.

To break a bond restricting liberty to search and say the truth may be more important than killing a definite positive error. The culture given by science can tolerate no distinct dogmatic brand.

A pertinent illustration is found in the attitude of the highest culture now toward language and language teaching. It is found that language, like the expression of numbers by symbols, has attained a higher state by taking aid from space concepts, by making definitely fixed use of position as significant.

The inflectional languages, such as Latin and Greek, correspond to their writing of numbers. There is a hint at some use of position. Witness IV. and VI., or the difference of emphasis given by position in the Latin sentence. But this is like confining the use of steam to the blowing of whistles. Compare 10 and .01, or a few English sentences with their Latin translations. Like the Hindoo discovery of the zero and consequent modern arithmetic is the organic use of position in language as typified by English.

Again, the number system of every child is at first *one, two, many*. The third number, the indefinite, takes different forms, 'some,' 'a few,' 'a lot,' etc. But the mental step from knowing *two* up to knowing *three*, recognizing a class or aggregate as just exactly possessing the distinctive quality *three*, as being triple or a triplet, is a slow and long and difficult step. In the high-bred, smart American child this step represents roughly a whole year's development, which cannot be much hastened.

Now, just this child stage, with the enormously undue importance which it attaches to the number two, is represented by the whole Greek language and grammar. This speech has a whole system of grammatical forms, called duals, whose creation rests wholly on the baby mistake, the child misconception of *two*. To babies and to Greek grammar *two* is still a god in a trinity.

A modern writer speaks slightingly of 'the aping and prolonged caw called grammar, the cackling of the human hen over the egg of language,' but may not the laborious puerilities which have so long passed current as Latin and Greek grammar be of interest to the scientist in comparative child study? "A single scientific idea may germinate into a hundred arts."

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CONVENTION OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE American Society of Mechanical Engineers held its annual spring convention at St. Louis recently, discussed a number of valuable papers, visited many points of interest and enjoyed informal meetings for social purposes. The papers were less numerous than usual and included fewer very striking or novel communications than ordinarily.* The convention was fairly well attended and very greatly enjoyed by all who took part.

The Secretary of the Society, Prof. Hutton, presented a discussion of the catalogue system proposed for engineering libraries. Dewey's 'Decimal Classification' was considered a model difficult to excel for general purposes. For an engineering collection, however, further classification is required, and the writer of the paper proposed a special scheme including twenty-two heads, each covering a division of engineering science or art. To these were appended about

* The papers will appear in the Transactions of the A. S. M. E., Vol. XVII., 1896.

a dozen other heads to cover accessions in the fields of general literature, more or less of which is found in every technical collection. The schedule is very complete and was thought a most satisfactory one.

Mr. Murray offered a paper on 'Structural Steel Fly Wheels.' The rapid increase in the employment of 'high-speed' engines, especially in electric light and power stations, where great irregularity of load is usual, has made the 'running away' of engines a comparatively frequent occurrence, and accidents of great importance are not unusual, involving loss of life and great destruction of property. The weakness of the older type of fly wheel, due partly to the fact that it is constructed of cast iron, partly to its inefficient connection of parts, makes it liable to go to pieces at a comparatively low speed, and gives but small margin above the ordinary working speed. Where, as is probably not very uncommon, an engine, when suddenly deprived of load, jumps up to double speed before the governor can act, or at a time, as is also not unusual, when the governor is not acting, the old cast-iron wheel is very sure to go to pieces and to produce the effect of an exploding giant bomb-shell. Various constructions of wrought-iron and steel wheels have been introduced, and Mr. Murray described a steel wheel made of open-hearth structural steel of about 60,000 pounds tenacity, and built up of a series of discs forming the hub, of a pair of dished disks constituting the main portion of the wheel in place of the ordinary arms, and a rim composed of heavy steel boiler plate; all rivetted together in such manner as to give a factor-of-safety, as computed by the writer of the paper, of twenty-six. All details are given and the construction fully described.

Prof. Goss exhibited the effect of long connections upon the action of steam in the steam-engine indicator and on the diagram, as experimentally determined by him. He found that even short pipe connections were likely to invalidate conclusions drawn from the diagram regarding the character of the expansion and compression line or the quality of the steam. For usual lengths of connection the area of the diagram will be greater than that of a true diagram, though that area may vary in either direction from the proper dimensions. To secure reliable results the indicator must be attached to the steam cylinder by very short and perfectly straight pipes.

Mr. Whitham described the recent 'mechanical stokers.' Of late years the supply of fuel to the furnace of the steam-boiler and the management of the fire has been effected by the employment of these machines, which, very various in form, all have the common function above described. Their advantages, when successful, are their adaptability to the cheap fuels; their reduction, in large 'plants,' of the cost of labor, by about forty per cent.; their economy of use of fuel, and the constancy or uniformity of conditions of combustion which lies behind the last-named advantage. They are, however, costly, both in manufacture and in repairs, are dependent upon the action of a steam-engine and a steam-blast, and are necessarily dependent, also, upon special skill on the part of the attendants. Anything going wrong, the whole establishment may come to a standstill.

Several forms of stoker are described and their performance, as ascertained by trials, tabulated. A number are found to be efficient for special cases, each in its own province. The engines use a fraction of one per cent. of the steam made; the fans demand three to five per cent., and the steam blasts from five to eleven per cent. in the cases described. The 'stoker' is less adaptable to a fluctuating demand for steam than is hand-firing; but it is constant in maintenance of a fire in good order, and

saves handsomely when operated under favorable conditions on a large scale.

Prof. Carpenter described a new form of steam 'calorimeter' employed at Sibley College, Cornell University, in the determination of the 'quality' of steam. It consists simply of a small chamber, jacketed with steam, a water-glass gauge and a specially graduated pressure gauge. Discharge takes place through a 'standard orifice," and the gauge indicates the flow in the unit of time. The separated moisture is collected in the reservoir, and its weight is compared with that of the indicated volume of dry steam discharged, to give a measure of the original quality of the vapor. The instrument had been in use about a year, in the form described, and found very accurate and satisfactory after prolonged comparison with the familiar forms of apparatus employed for the same purpose.

Mr. Alberger presented an account of a 'self-cooling condenser' for use where condensing water for the steam engine is difficult to obtain or costly. These systems of cooling the water of condensation for repeated use in a circulation comprehending the condenser and a cooling tower or other device for the removal of the heat taken up from the steam, are coming rapidly into use in many localities. That described consists of a tower in which is installed a large mass of tiling, over which the water circulates and in the midst of which large volumes of air are circulated by the action of a fan blast. A steam-pump circulates the water from condenser to the top of the tower and back in a continually moving stream flooding the tiling; drawing water from a well or tank at the foot of the tower, and passing it through the condenser and then through the masses of tile in the cooling tower, the water finally falling into the well after its temperature has again been reduced to the minimum. The fan requires less than two per cent. of the power of the main engine; it may not exceed one per cent. The heat is carried away mainly by evaporation into the rising current of air from the fan. The cost is stated at about that of one pound of water per horse power per hour as used in the engines, including all expenses of steam-making.

Mr. Kent discussed the definition of steam-boiler 'efficiency,' as that term is now applied in connection with the boiler-trials made under the now usual forms of standard tests. The paper indicated the nature and extent of the difficulties arising in the endeavor to obtain the unit of measurement, and in its application to the numerical rating of boiler efficiencies; showing that the uncertainties introduced through the inaccuracy of existing methods of measuring the total heating power of a fuel, and in thus obtaining a basis of comparison, might be so great as to preclude any possible uniformity or accuracy of measurement of the true efficiency of the boiler. Two illustrative cases were presented in the paper. The heating power of a coal was reported by two different systems of calorimetric measurement, as respectively, 13, 302 and 14, 620 from different calorimeters, and, in the other case, 13,799 and 16,212 B. T. U. per pound. The boiler thus received credits for efficiency, ranging from 56.66 to 66.37 in the one case, and from 73.12 to 85.83 in the other, accordingly as one or another calorimeter was employed to do the work of measuring the 'actual' heating power of the fuel.

Prof. Thurston presented a paper on 'Superheated Steam; Facts, Data and Principles Relating to the Problem of its Use.' The nature of superheated steam, its thermal and thermodynamic properties and its value in the steam-engine were studied. Its only use to-day is that of reducing internal wastes by 'cylinder condensation,' through the process of supplying sufficient

heat to the cylinder wall to check that initial loss. It has no thermodynamic value, in a proper sense, as it does not increase the range of adiabatic expansion. The economical value of superheating and of 'reheating' between the cylinders of the multiple-cylinder engine was discussed, and illustrations were given from the reported results of engine trials, showing that superheating is more effective than other expedients for the prevention of internal waste. By reference to experiments reported in large numbers on the value of heat transferred to the steam by steam-jackets for the same purpose, the conclusion was drawn that for each unit of heat expended in the prevention of this waste several could usually be saved in the engine. For simple engines this ratio of saving to expense amounted to an average of six and seven; for compound engines, to between three and four, the gain being the less as the engine is the more economical originally. Experience in Europe, far more than in the United States, affords fact and datum for the conclusions reached. The Schmidt superheating engine, reported upon by Schroeter, of Munich, gives the horse power on but 10.2 pounds of steam per hour; the pressure being about 125 pounds and the engine one of moderate size. The little twenty-horse-power engine of Sibley College, operated with 300 to 500 pounds of steam, as elsewhere described, is here stated to give the horse-power, the steam being saturated at the high-pressure cylinder and reheated between cylinders with 'less than ten pounds, 11,000 B. T. U., per horse power per hour.' The conclusion is reached that "This is, to-day, the greatest of all the problems presented to the designing and constructing engineer, with the possible exception of that of finding a system of effectually rendering the interior of the working cylinder non-conducting in such manner as to entirely prevent the occurrence of initial condensation; thus conforming the 'ideal case' to the real, and making the steam engine a purely thermodynamic machine."

A number of papers were read describing details of practical engineering work and a set of 'topical questions' was propounded; both papers and questions eliciting much interesting discussion bearing upon practical, rather than scientific, points in engineering.

CURRENT NOTES ON ANTHROPOLOGY.

THE SCIENCE OF LANGUAGE.

Within the compass of about 300 duodecimo pages, Prof. Giacomo de Gregorio, of the University of Palermo, has compressed an admirable survey of the elements of the science of language, a task by no means easy. ('Glottologia.' Ulric Hoepli, Milan, 1896.)

He divides the subject into three parts, glottology, language in general, and particular languages. In the first he discusses the place of the study of language among the sciences, and rapidly sketches its historic development, naming the most prominent students and their works. The second part enters fully into the phonetics and the physiology of articulate sounds, and in a second chapter reviews the theories of linguistic radicals and the origin of speech. The third part presents an able chapter on the various proposed classifications of languages, and a summary of the principal linguistic stocks of the globe. An excellent bibliography of linguistic writings precedes the text.

The author is much more than a compiler. He is an independent and acute critic, and threads his way with clear vision through the dust and fog of conflicting hypotheses and averments. He is not a supporter of any 'school,' but claims for linguistic science the high and right place that it deserves among the natural sciences relating to man, and his method is that of those sciences.